

Experimental design to install PV modules on mounted roofs

Multilevel Factorial Design

Factors: 3 Replicates: 1
Base runs: 56 Total runs: 56
Base blocks: 1 Total blocks: 1

Number of levels: 2, 4, 7

General Factorial Regression: Rio de Janeiro versus PVT, PVO, PVIA

Factor Information

Factor	Levels	Values
PVT	2	1, 2
PVO	4	1, 2, 3, 4
PVIA	7	1, 2, 3, 4, 5, 6, 7

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	55	204494502	3718082	*	*
Linear	10	177165629	17716563	*	*
PVT	1	119510	119510	*	*
PVO	3	79618296	26539432	*	*
PVIA	6	97427823	16237970	*	*
2-Way Interactions	27	27327878	1012144	*	*
PVT*PVO	3	978	326	*	*
PVT*PVIA	6	86	14	*	*
PVO*PVIA	18	27326814	1518156	*	*
3-Way Interactions	18	994	55	*	*
PVT*PVO*PVIA	18	994	55	*	*
Error	0	*	*		
Total	55	204494502			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
*	100.00%	*	*

Coefficients

Term	Coef	SE	T-Value	P-Value	VIF
Constant	11685	*	*	*	
PVT					
1	46.20	*	*	*	1.00
PVO					
1	1435	*	*	*	1.50
2	-1873	*	*	*	1.50

3	331.0	*	*	*	1.50
PVIA					
1	1490	*	*	*	1.71
2	1340	*	*	*	1.71
3	937.4	*	*	*	1.71
4	315.3	*	*	*	1.71
5	-473.1	*	*	*	1.71
6	-1331	*	*	*	1.71
PVT*PVO					
1 1	-2.696	*	*	*	1.50
1 2	7.232	*	*	*	1.50
1 3	-2.196	*	*	*	1.50
PVT*PVIA					
1 1	-0.1964	*	*	*	1.71
1 2	-0.5714	*	*	*	1.71
1 3	-0.6964	*	*	*	1.71
1 4	-1.071	*	*	*	1.71
1 5	-0.9464	*	*	*	1.71
1 6	0.8036	*	*	*	1.71
PVO*PVIA					
1 1	-1435	*	*	*	2.57
1 2	-764.4	*	*	*	2.57
1 3	-171.3	*	*	*	2.57
1 4	313.4	*	*	*	2.57
1 5	651.2	*	*	*	2.57
1 6	750.0	*	*	*	2.57
2 1	1873	*	*	*	2.57
2 2	1182	*	*	*	2.57
2 3	473.7	*	*	*	2.57
2 4	-237.6	*	*	*	2.57
2 5	-850.3	*	*	*	2.57
2 6	-1168	*	*	*	2.57
3 1	-331.0	*	*	*	2.57
3 2	-274.4	*	*	*	2.57
3 3	-172.8	*	*	*	2.57
3 4	-16.14	*	*	*	2.57
3 5	149.2	*	*	*	2.57
3 6	269.0	*	*	*	2.57
PVT*PVO*PVIA					
1 1 1	2.696	*	*	*	2.57
1 1 2	-3.429	*	*	*	2.57
1 1 3	-7.304	*	*	*	2.57
1 1 4	-6.429	*	*	*	2.57
1 1 5	-1.054	*	*	*	2.57
1 1 6	4.696	*	*	*	2.57
1 2 1	-7.232	*	*	*	2.57
1 2 2	0.1429	*	*	*	2.57
1 2 3	6.268	*	*	*	2.57
1 2 4	7.143	*	*	*	2.57
1 2 5	3.018	*	*	*	2.57
1 2 6	-1.732	*	*	*	2.57
1 3 1	2.196	*	*	*	2.57
1 3 2	1.571	*	*	*	2.57
1 3 3	0.1964	*	*	*	2.57
1 3 4	-0.9286	*	*	*	2.57
1 3 5	-1.054	*	*	*	2.57
1 3 6	-1.304	*	*	*	2.57

Regression Equation

$$\begin{aligned} \text{Rio de Janeiro} = & 11685 + 46.20 \text{ PVT_1} - 46.20 \text{ PVT_2} + 1435 \text{ PVO_1} \\ & - 1873 \text{ PVO_2} + 331.0 \text{ PVO_3} + 107.4 \text{ PVO_4} \\ & + 1490 \text{ PVIA_1} + 1340 \text{ PVIA_2} + 937.4 \text{ PVIA_3} + 315.3 \text{ PVIA_4} \\ & - 473.1 \text{ PVIA_5} - 1331 \text{ PVIA_6} \\ & - 2278 \text{ PVIA_7} - 2.696 \text{ PVT*PVO_1 1} + 7.232 \text{ PVT*PVO_1 2} \\ & - 2.196 \text{ PVT*PVO_1 3} \\ & - 2.339 \text{ PVT*PVO_1 4} + 2.696 \text{ PVT*PVO_2 1} - 7.232 \text{ PVT*PVO_2 2} \\ & + 2.196 \text{ PVT*PVO_2 3} \\ & + 2.339 \text{ PVT*PVO_2 4} - 0.1964 \text{ PVT*PVIA_1 1} - 0.5714 \text{ PVT*PVIA_1 2} \\ & - 0.6964 \text{ PVT*PVIA_1 3} \\ & - 1.071 \text{ PVT*PVIA_1 4} - 0.9464 \text{ PVT*PVIA_1 5} + 0.8036 \text{ PVT*PVIA_1 6} \\ & + 2.679 \text{ PVT*PVIA_1 7} \\ & + 0.1964 \text{ PVT*PVIA_2 1} + 0.5714 \text{ PVT*PVIA_2 2} + 0.6964 \text{ PVT*PVIA_2 3} \\ & + 1.071 \text{ PVT*PVIA_2 4} \\ & + 0.9464 \text{ PVT*PVIA_2 5} - 0.8036 \text{ PVT*PVIA_2 6} - 2.679 \text{ PVT*PVIA_2 7} \\ & - 1435 \text{ PVO*PVIA_1 1} \\ & - 764.4 \text{ PVO*PVIA_1 2} - 171.3 \text{ PVO*PVIA_1 3} + 313.4 \text{ PVO*PVIA_1 4} \\ & + 651.2 \text{ PVO*PVIA_1 5} \\ & + 750.0 \text{ PVO*PVIA_1 6} + 655.6 \text{ PVO*PVIA_1 7} + 1873 \text{ PVO*PVIA_2 1} \\ & + 1182 \text{ PVO*PVIA_2 2} \\ & + 473.7 \text{ PVO*PVIA_2 3} - 237.6 \text{ PVO*PVIA_2 4} - 850.3 \text{ PVO*PVIA_2 5} \\ & - 1168 \text{ PVO*PVIA_2 6} \\ & - 1272 \text{ PVO*PVIA_2 7} - 331.0 \text{ PVO*PVIA_3 1} - 274.4 \text{ PVO*PVIA_3 2} \\ & - 172.8 \text{ PVO*PVIA_3 3} \\ & - 16.14 \text{ PVO*PVIA_3 4} + 149.2 \text{ PVO*PVIA_3 5} + 269.0 \text{ PVO*PVIA_3 6} \\ & + 376.1 \text{ PVO*PVIA_3 7} \\ & - 107.4 \text{ PVO*PVIA_4 1} - 142.8 \text{ PVO*PVIA_4 2} - 129.7 \text{ PVO*PVIA_4 3} \\ & - 59.57 \text{ PVO*PVIA_4 4} \\ & + 49.80 \text{ PVO*PVIA_4 5} + 149.1 \text{ PVO*PVIA_4 6} + 240.7 \text{ PVO*PVIA_4 7} \\ & + 2.696 \text{ PVT*PVO*PVIA_1 1} \\ & - 3.429 \text{ PVT*PVO*PVIA_1 1 2} - 7.304 \text{ PVT*PVO*PVIA_1 1 3} \\ & - 6.429 \text{ PVT*PVO*PVIA_1 1 4} \\ & - 1.054 \text{ PVT*PVO*PVIA_1 1 5} + 4.696 \text{ PVT*PVO*PVIA_1 1 6} \\ & + 10.82 \text{ PVT*PVO*PVIA_1 1 7} \\ & - 7.232 \text{ PVT*PVO*PVIA_1 2 1} + 0.1429 \text{ PVT*PVO*PVIA_1 2 2} \\ & + 6.268 \text{ PVT*PVO*PVIA_1 2 3} \\ & + 7.143 \text{ PVT*PVO*PVIA_1 2 4} + 3.018 \text{ PVT*PVO*PVIA_1 2 5} \\ & - 1.732 \text{ PVT*PVO*PVIA_1 2 6} \\ & - 7.607 \text{ PVT*PVO*PVIA_1 2 7} + 2.196 \text{ PVT*PVO*PVIA_1 3 1} \\ & + 1.571 \text{ PVT*PVO*PVIA_1 3 2} \\ & + 0.1964 \text{ PVT*PVO*PVIA_1 3 3} - 0.9286 \text{ PVT*PVO*PVIA_1 3 4} \\ & - 1.054 \text{ PVT*PVO*PVIA_1 3 5} \\ & - 1.304 \text{ PVT*PVO*PVIA_1 3 6} - 0.6786 \text{ PVT*PVO*PVIA_1 3 7} \\ & + 2.339 \text{ PVT*PVO*PVIA_1 4 1} \\ & + 1.714 \text{ PVT*PVO*PVIA_1 4 2} + 0.8393 \text{ PVT*PVO*PVIA_1 4 3} \\ & + 0.2143 \text{ PVT*PVO*PVIA_1 4 4} \\ & - 0.9107 \text{ PVT*PVO*PVIA_1 4 5} - 1.661 \text{ PVT*PVO*PVIA_1 4 6} \\ & - 2.536 \text{ PVT*PVO*PVIA_1 4 7} \\ & - 2.696 \text{ PVT*PVO*PVIA_2 1 1} + 3.429 \text{ PVT*PVO*PVIA_2 1 2} \\ & + 7.304 \text{ PVT*PVO*PVIA_2 1 3} \\ & + 6.429 \text{ PVT*PVO*PVIA_2 1 4} + 1.054 \text{ PVT*PVO*PVIA_2 1 5} \\ & - 4.696 \text{ PVT*PVO*PVIA_2 1 6} \\ & - 10.82 \text{ PVT*PVO*PVIA_2 1 7} + 7.232 \text{ PVT*PVO*PVIA_2 2 1} \\ & - 0.1429 \text{ PVT*PVO*PVIA_2 2 2} \end{aligned}$$

- 6.268 PVT*PVO*PVIA_2 2 3 - 7.143 PVT*PVO*PVIA_2 2 4
 - 3.018 PVT*PVO*PVIA_2 2 5
 + 1.732 PVT*PVO*PVIA_2 2 6 + 7.607 PVT*PVO*PVIA_2 2 7
 - 2.196 PVT*PVO*PVIA_2 3 1
 - 1.571 PVT*PVO*PVIA_2 3 2 - 0.1964 PVT*PVO*PVIA_2 3 3
 + 0.9286 PVT*PVO*PVIA_2 3 4
 + 1.054 PVT*PVO*PVIA_2 3 5 + 1.304 PVT*PVO*PVIA_2 3 6
 + 0.6786 PVT*PVO*PVIA_2 3 7
 - 2.339 PVT*PVO*PVIA_2 4 1 - 1.714 PVT*PVO*PVIA_2 4 2
 - 0.8393 PVT*PVO*PVIA_2 4 3
 - 0.2143 PVT*PVO*PVIA_2 4 4 + 0.9107 PVT*PVO*PVIA_2 4 5
 + 1.661 PVT*PVO*PVIA_2 4 6
 + 2.536 PVT*PVO*PVIA_2 4 7

* NOTE * Could not graph the specified residual type because MSE = 0 or
 the degrees of
 freedom for error = 0.

General Factorial Regression: Riyadh versus PVT, PVO, PVIA

Factor Information

Factor	Levels	Values
PVT	2	1, 2
PVO	4	1, 2, 3, 4
PVIA	7	1, 2, 3, 4, 5, 6, 7

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	55	502020412	9127644	*	*
Linear	10	424392780	42439278	*	*
PVT	1	5680	5680	*	*
PVO	3	225415795	75138598	*	*
PVIA	6	198971305	33161884	*	*
2-Way Interactions	27	77623127	2874931	*	*
PVT*PVO	3	12719	4240	*	*
PVT*PVIA	6	7755	1292	*	*
PVO*PVIA	18	77602653	4311259	*	*
3-Way Interactions	18	4505	250	*	*
PVT*PVO*PVIA	18	4505	250	*	*
Error	0	*	*		
Total	55	502020412			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
*	100.00%	*	*

Coefficients

Term	Coef	SE	T-Value	P-Value	VIF
		Coef			

Constant	14938	*	*	*	
PVT					
1	-10.07	*	*	*	1.00
PVO					
1	-3153	*	*	*	1.50
2	2428	*	*	*	1.50
3	398.8	*	*	*	1.50
PVIA					
1	2143	*	*	*	1.71
2	1927	*	*	*	1.71
3	1334	*	*	*	1.71
4	429.6	*	*	*	1.71
5	-685.9	*	*	*	1.71
6	-1910	*	*	*	1.71
PVT*PVO					
1 1	23.86	*	*	*	1.50
1 2	-15.86	*	*	*	1.50
1 3	1.286	*	*	*	1.50
PVT*PVIA					
1 1	-10.93	*	*	*	1.71
1 2	-10.30	*	*	*	1.71
1 3	-8.679	*	*	*	1.71
1 4	-5.179	*	*	*	1.71
1 5	1.071	*	*	*	1.71
1 6	11.45	*	*	*	1.71
PVO*PVIA					
1 1	3153	*	*	*	2.57
1 2	1988	*	*	*	2.57
1 3	796.9	*	*	*	2.57
1 4	-397.1	*	*	*	2.57
1 5	-1393	*	*	*	2.57
1 6	-1952	*	*	*	2.57
2 1	-2428	*	*	*	2.57
2 2	-1302	*	*	*	2.57
2 3	-299.4	*	*	*	2.57
2 4	517.6	*	*	*	2.57
2 5	1083	*	*	*	2.57
2 6	1287	*	*	*	2.57
3 1	-398.8	*	*	*	2.57
3 2	-364.1	*	*	*	2.57
3 3	-253.5	*	*	*	2.57
3 4	-56.50	*	*	*	2.57
3 5	177.0	*	*	*	2.57
3 6	353.6	*	*	*	2.57
PVT*PVO*PVIA					
1 1 1	-23.86	*	*	*	2.57
1 1 2	-4.982	*	*	*	2.57
1 1 3	9.893	*	*	*	2.57
1 1 4	14.89	*	*	*	2.57
1 1 5	10.14	*	*	*	2.57
1 1 6	3.268	*	*	*	2.57
1 2 1	15.86	*	*	*	2.57
1 2 2	-1.268	*	*	*	2.57
1 2 3	-11.89	*	*	*	2.57
1 2 4	-13.89	*	*	*	2.57
1 2 5	-7.643	*	*	*	2.57
1 2 6	2.982	*	*	*	2.57

1 3 1	-1.286	*	*	*	2.57
1 3 2	0.08929	*	*	*	2.57
1 3 3	-0.03571	*	*	*	2.57
1 3 4	-0.03571	*	*	*	2.57
1 3 5	0.7143	*	*	*	2.57
1 3 6	-0.1607	*	*	*	2.57

Regression Equation

Riyadh = 14938 - 10.07 PVT_1 + 10.07 PVT_2 - 3153 PVO_1 + 2428 PVO_2
 + 398.8 PVO_3 + 326.7 PVO_4
 + 2143 PVIA_1 + 1927 PVIA_2 + 1334 PVIA_3 + 429.6 PVIA_4
 - 685.9 PVIA_5 - 1910 PVIA_6
 - 3238 PVIA_7 + 23.86 PVT*PVO_1 1 - 15.86 PVT*PVO_1 2
 + 1.286 PVT*PVO_1 3
 - 9.286 PVT*PVO_1 4 - 23.86 PVT*PVO_2 1 + 15.86 PVT*PVO_2 2
 - 1.286 PVT*PVO_2 3
 + 9.286 PVT*PVO_2 4 - 10.93 PVT*PVIA_1 1 - 10.30 PVT*PVIA_1 2
 - 8.679 PVT*PVIA_1 3
 - 5.179 PVT*PVIA_1 4 + 1.071 PVT*PVIA_1 5 + 11.45 PVT*PVIA_1 6
 + 22.57 PVT*PVIA_1 7
 + 10.93 PVT*PVIA_2 1 + 10.30 PVT*PVIA_2 2 + 8.679 PVT*PVIA_2 3
 + 5.179 PVT*PVIA_2 4
 - 1.071 PVT*PVIA_2 5 - 11.45 PVT*PVIA_2 6 - 22.57 PVT*PVIA_2 7
 + 3153 PVO*PVIA_1 1
 + 1988 PVO*PVIA_1 2 + 796.9 PVO*PVIA_1 3 - 397.1 PVO*PVIA_1 4
 - 1393 PVO*PVIA_1 5
 - 1952 PVO*PVIA_1 6 - 2196 PVO*PVIA_1 7 - 2428 PVO*PVIA_2 1
 - 1302 PVO*PVIA_2 2
 - 299.4 PVO*PVIA_2 3 + 517.6 PVO*PVIA_2 4 + 1083 PVO*PVIA_2 5
 + 1287 PVO*PVIA_2 6
 + 1142 PVO*PVIA_2 7 - 398.8 PVO*PVIA_3 1 - 364.1 PVO*PVIA_3 2
 - 253.5 PVO*PVIA_3 3
 - 56.50 PVO*PVIA_3 4 + 177.0 PVO*PVIA_3 5 + 353.6 PVO*PVIA_3 6
 + 542.2 PVO*PVIA_3 7
 - 326.8 PVO*PVIA_4 1 - 321.6 PVO*PVIA_4 2 - 244.0 PVO*PVIA_4 3
 - 64.00 PVO*PVIA_4 4
 + 133.5 PVO*PVIA_4 5 + 311.1 PVO*PVIA_4 6 + 511.8 PVO*PVIA_4 7
 - 23.86 PVT*PVO*PVIA_1 1
 1 - 4.982 PVT*PVO*PVIA_1 1 2 + 9.893 PVT*PVO*PVIA_1 1 3
 + 14.89 PVT*PVO*PVIA_1 1 4
 + 10.14 PVT*PVO*PVIA_1 1 5 + 3.268 PVT*PVO*PVIA_1 1 6
 - 9.357 PVT*PVO*PVIA_1 1 7
 + 15.86 PVT*PVO*PVIA_1 2 1 - 1.268 PVT*PVO*PVIA_1 2 2
 - 11.89 PVT*PVO*PVIA_1 2 3
 - 13.89 PVT*PVO*PVIA_1 2 4 - 7.643 PVT*PVO*PVIA_1 2 5
 + 2.982 PVT*PVO*PVIA_1 2 6
 + 15.86 PVT*PVO*PVIA_1 2 7 - 1.286 PVT*PVO*PVIA_1 3 1
 + 0.08929 PVT*PVO*PVIA_1 3 2
 - 0.03571 PVT*PVO*PVIA_1 3 3 - 0.03571 PVT*PVO*PVIA_1 3 4
 + 0.7143 PVT*PVO*PVIA_1 3 5
 - 0.1607 PVT*PVO*PVIA_1 3 6 + 0.7143 PVT*PVO*PVIA_1 3 7
 + 9.286 PVT*PVO*PVIA_1 4 1
 + 6.161 PVT*PVO*PVIA_1 4 2 + 2.036 PVT*PVO*PVIA_1 4 3
 - 0.9643 PVT*PVO*PVIA_1 4 4

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- 3.214 PVT*PVO*PVIA_1 4 5 - 6.089 PVT*PVO*PVIA_1 4 6
- 7.214 PVT*PVO*PVIA_1 4 7
+ 23.86 PVT*PVO*PVIA_2 1 1 + 4.982 PVT*PVO*PVIA_2 1 2
- 9.893 PVT*PVO*PVIA_2 1 3
- 14.89 PVT*PVO*PVIA_2 1 4 - 10.14 PVT*PVO*PVIA_2 1 5
- 3.268 PVT*PVO*PVIA_2 1 6
+ 9.357 PVT*PVO*PVIA_2 1 7 - 15.86 PVT*PVO*PVIA_2 2 1
+ 1.268 PVT*PVO*PVIA_2 2 2
+ 11.89 PVT*PVO*PVIA_2 2 3 + 13.89 PVT*PVO*PVIA_2 2 4
+ 7.643 PVT*PVO*PVIA_2 2 5
- 2.982 PVT*PVO*PVIA_2 2 6 - 15.86 PVT*PVO*PVIA_2 2 7
+ 1.286 PVT*PVO*PVIA_2 3 1
- 0.08929 PVT*PVO*PVIA_2 3 2 + 0.03571 PVT*PVO*PVIA_2 3 3
+ 0.03571 PVT*PVO*PVIA_2 3 4
- 0.7143 PVT*PVO*PVIA_2 3 5 + 0.1607 PVT*PVO*PVIA_2 3 6
- 0.7143 PVT*PVO*PVIA_2 3 7
- 9.286 PVT*PVO*PVIA_2 4 1 - 6.161 PVT*PVO*PVIA_2 4 2
- 2.036 PVT*PVO*PVIA_2 4 3
+ 0.9643 PVT*PVO*PVIA_2 4 4 + 3.214 PVT*PVO*PVIA_2 4 5
+ 6.089 PVT*PVO*PVIA_2 4 6
+ 7.214 PVT*PVO*PVIA_2 4 7

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* NOTE * Could not graph the specified residual type because MSE = 0 or the degrees of freedom for error = 0.

General Factorial Regression: London versus PVT, PVO, PVIA

Factor Information

Factor	Levels	Values
PVT	2	1, 2
PVO	4	1, 2, 3, 4
PVIA	7	1, 2, 3, 4, 5, 6, 7

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	55	108797364	1978134	*	*
Linear	10	86693362	8669336	*	*
PVT	1	250313	250313	*	*
PVO	3	69968710	23322903	*	*
PVIA	6	16474339	2745723	*	*
2-Way Interactions	27	22102354	818606	*	*
PVT*PVO	3	2537	846	*	*
PVT*PVIA	6	4811	802	*	*
PVO*PVIA	18	22095006	1227500	*	*
3-Way Interactions	18	1648	92	*	*
PVT*PVO*PVIA	18	1648	92	*	*
Error	0	*	*		
Total	55	108797364			

Model Summary

S R-sq R-sq(adj) R-sq(pred)
 * 100.00% * *

Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	7076	*	*	*	
PVT					
1	66.86	*	*	*	1.00
PVO					
1	-1685	*	*	*	1.50
2	1461	*	*	*	1.50
3	88.61	*	*	*	1.50
PVIA					
1	604.0	*	*	*	1.71
2	537.8	*	*	*	1.71
3	378.8	*	*	*	1.71
4	-542.2	*	*	*	1.71
5	-162.2	*	*	*	1.71
6	143.3	*	*	*	1.71
PVT*PVO					
1 1	-10.57	*	*	*	1.50
1 2	7.929	*	*	*	1.50
1 3	2.571	*	*	*	1.50
PVT*PVIA					
1 1	11.64	*	*	*	1.71
1 2	9.768	*	*	*	1.71
1 3	6.018	*	*	*	1.71
1 4	-9.982	*	*	*	1.71
1 5	-3.982	*	*	*	1.71
1 6	1.268	*	*	*	1.71
PVO*PVIA					
1 1	1685	*	*	*	2.57
1 2	970.2	*	*	*	2.57
1 3	325.2	*	*	*	2.57
1 4	-989.8	*	*	*	2.57
1 5	-686.8	*	*	*	2.57
1 6	-243.3	*	*	*	2.57
2 1	-1461	*	*	*	2.57
2 2	-772.2	*	*	*	2.57
2 3	-191.2	*	*	*	2.57
2 4	772.8	*	*	*	2.57
2 5	594.3	*	*	*	2.57
2 6	272.3	*	*	*	2.57
3 1	-88.61	*	*	*	2.57
3 2	-89.48	*	*	*	2.57
3 3	-65.98	*	*	*	2.57
3 4	97.52	*	*	*	2.57
3 5	38.52	*	*	*	2.57
3 6	-18.48	*	*	*	2.57
PVT*PVO*PVIA					
1 1 1	10.57	*	*	*	2.57
1 1 2	7.946	*	*	*	2.57
1 1 3	5.696	*	*	*	2.57

1 1 4	-9.304	*	*	*	2.57
1 1 5	-2.304	*	*	*	2.57
1 1 6	2.446	*	*	*	2.57
1 2 1	-7.929	*	*	*	2.57
1 2 2	-5.554	*	*	*	2.57
1 2 3	-3.804	*	*	*	2.57
1 2 4	6.196	*	*	*	2.57
1 2 5	1.696	*	*	*	2.57
1 2 6	-1.054	*	*	*	2.57
1 3 1	-2.571	*	*	*	2.57
1 3 2	-1.696	*	*	*	2.57
1 3 3	-1.446	*	*	*	2.57
1 3 4	2.054	*	*	*	2.57
1 3 5	1.054	*	*	*	2.57
1 3 6	-0.6964	*	*	*	2.57

Regression Equation

London = 7076 + 66.86 PVT_1 - 66.86 PVT_2 - 1685 PVO_1 + 1461 PVO_2
 + 88.61 PVO_3 + 135.1 PVO_4
 + 604.0 PVIA_1 + 537.8 PVIA_2 + 378.8 PVIA_3 - 542.2 PVIA_4
 - 162.2 PVIA_5
 + 143.3 PVIA_6 - 959.7 PVIA_7 - 10.57 PVT*PVO_1 1
 + 7.929 PVT*PVO_1 2 + 2.571 PVT*PVO_1
 3 + 0.07143 PVT*PVO_1 4 + 10.57 PVT*PVO_2 1 - 7.929 PVT*PVO_2 2
 - 2.571 PVT*PVO_2 3
 - 0.07143 PVT*PVO_2 4 + 11.64 PVT*PVIA_1 1 + 9.768 PVT*PVIA_1 2
 + 6.018 PVT*PVIA_1 3
 - 9.982 PVT*PVIA_1 4 - 3.982 PVT*PVIA_1 5 + 1.268 PVT*PVIA_1 6
 - 14.73 PVT*PVIA_1 7
 - 11.64 PVT*PVIA_2 1 - 9.768 PVT*PVIA_2 2 - 6.018 PVT*PVIA_2 3
 + 9.982 PVT*PVIA_2 4
 + 3.982 PVT*PVIA_2 5 - 1.268 PVT*PVIA_2 6 + 14.73 PVT*PVIA_2 7
 + 1685 PVO*PVIA_1 1
 + 970.2 PVO*PVIA_1 2 + 325.2 PVO*PVIA_1 3 - 989.8 PVO*PVIA_1 4
 - 686.8 PVO*PVIA_1 5
 - 243.3 PVO*PVIA_1 6 - 1060 PVO*PVIA_1 7 - 1461 PVO*PVIA_2 1
 - 772.2 PVO*PVIA_2 2
 - 191.2 PVO*PVIA_2 3 + 772.8 PVO*PVIA_2 4 + 594.3 PVO*PVIA_2 5
 + 272.3 PVO*PVIA_2 6
 + 784.8 PVO*PVIA_2 7 - 88.61 PVO*PVIA_3 1 - 89.48 PVO*PVIA_3 2
 - 65.98 PVO*PVIA_3 3
 + 97.52 PVO*PVIA_3 4 + 38.52 PVO*PVIA_3 5 - 18.48 PVO*PVIA_3 6
 + 126.5 PVO*PVIA_3 7
 - 135.1 PVO*PVIA_4 1 - 108.5 PVO*PVIA_4 2 - 67.98 PVO*PVIA_4 3
 + 119.5 PVO*PVIA_4 4
 + 54.02 PVO*PVIA_4 5 - 10.48 PVO*PVIA_4 6 + 148.5 PVO*PVIA_4 7
 + 10.57 PVT*PVO*PVIA_1 1
 1 + 7.946 PVT*PVO*PVIA_1 1 2 + 5.696 PVT*PVO*PVIA_1 1 3
 - 9.304 PVT*PVO*PVIA_1 1 4
 - 2.304 PVT*PVO*PVIA_1 1 5 + 2.446 PVT*PVO*PVIA_1 1 6
 - 15.05 PVT*PVO*PVIA_1 1 7
 - 7.929 PVT*PVO*PVIA_1 2 1 - 5.554 PVT*PVO*PVIA_1 2 2
 - 3.804 PVT*PVO*PVIA_1 2 3
 + 6.196 PVT*PVO*PVIA_1 2 4 + 1.696 PVT*PVO*PVIA_1 2 5
 - 1.054 PVT*PVO*PVIA_1 2 6

```

+ 10.45 PVT*PVO*PVIA_1 2 7 - 2.571 PVT*PVO*PVIA_1 3 1
- 1.696 PVT*PVO*PVIA_1 3 2
- 1.446 PVT*PVO*PVIA_1 3 3 + 2.054 PVT*PVO*PVIA_1 3 4
+ 1.054 PVT*PVO*PVIA_1 3 5
- 0.6964 PVT*PVO*PVIA_1 3 6 + 3.304 PVT*PVO*PVIA_1 3 7
- 0.07143 PVT*PVO*PVIA_1 4 1
- 0.6964 PVT*PVO*PVIA_1 4 2 - 0.4464 PVT*PVO*PVIA_1 4 3
+ 1.054 PVT*PVO*PVIA_1 4 4
- 0.4464 PVT*PVO*PVIA_1 4 5 - 0.6964 PVT*PVO*PVIA_1 4 6
+ 1.304 PVT*PVO*PVIA_1 4 7
- 10.57 PVT*PVO*PVIA_2 1 1 - 7.946 PVT*PVO*PVIA_2 1 2
- 5.696 PVT*PVO*PVIA_2 1 3
+ 9.304 PVT*PVO*PVIA_2 1 4 + 2.304 PVT*PVO*PVIA_2 1 5
- 2.446 PVT*PVO*PVIA_2 1 6
+ 15.05 PVT*PVO*PVIA_2 1 7 + 7.929 PVT*PVO*PVIA_2 2 1
+ 5.554 PVT*PVO*PVIA_2 2 2
+ 3.804 PVT*PVO*PVIA_2 2 3 - 6.196 PVT*PVO*PVIA_2 2 4
- 1.696 PVT*PVO*PVIA_2 2 5
+ 1.054 PVT*PVO*PVIA_2 2 6 - 10.45 PVT*PVO*PVIA_2 2 7
+ 2.571 PVT*PVO*PVIA_2 3 1
+ 1.696 PVT*PVO*PVIA_2 3 2 + 1.446 PVT*PVO*PVIA_2 3 3
- 2.054 PVT*PVO*PVIA_2 3 4
- 1.054 PVT*PVO*PVIA_2 3 5 + 0.6964 PVT*PVO*PVIA_2 3 6
- 3.304 PVT*PVO*PVIA_2 3 7
+ 0.07143 PVT*PVO*PVIA_2 4 1 + 0.6964 PVT*PVO*PVIA_2 4 2
+ 0.4464 PVT*PVO*PVIA_2 4 3
- 1.054 PVT*PVO*PVIA_2 4 4 + 0.4464 PVT*PVO*PVIA_2 4 5
+ 0.6964 PVT*PVO*PVIA_2 4 6
- 1.304 PVT*PVO*PVIA_2 4 7

```

* NOTE * Could not graph the specified residual type because MSE = 0 or the degrees of freedom for error = 0.

General Factorial Regression: Quito versus PVT, PVO, PVIA

Factor Information

Factor	Levels	Values
PVT	2	1, 2
PVO	4	1, 2, 3, 4
PVIA	7	1, 2, 3, 4, 5, 6, 7

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	55	215043144	3909875	*	*
Linear	10	203947509	20394751	*	*
PVT	1	393290	393290	*	*
PVO	3	11584852	3861617	*	*
PVIA	6	191969366	31994894	*	*
2-Way Interactions	27	11092341	410827	*	*
PVT*PVO	3	6077	2026	*	*
PVT*PVIA	6	376	63	*	*

PVO*PVIA	18	11085888	615883	*	*
3-Way Interactions	18	3293	183	*	*
PVT*PVO*PVIA	18	3293	183	*	*
Error	0	*	*		
Total	55	215043144			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
*	100.00%	*	*

Coefficients

Term	Coef	SE	T-Value	P-Value	VIF
Constant	14947	*	*	*	
PVT					
1	83.80	*	*	*	1.00
PVO					
1	-350.4	*	*	*	1.50
2	-512.1	*	*	*	1.50
3	619.1	*	*	*	1.50
PVIA					
1	2036	*	*	*	1.71
2	1840	*	*	*	1.71
3	1314	*	*	*	1.71
4	501.7	*	*	*	1.71
5	-563.4	*	*	*	1.71
6	-1851	*	*	*	1.71
PVT*PVO					
1 1	8.911	*	*	*	1.50
1 2	11.41	*	*	*	1.50
1 3	-7.161	*	*	*	1.50
PVT*PVIA					
1 1	-4.804	*	*	*	1.71
1 2	-2.429	*	*	*	1.71
1 3	1.571	*	*	*	1.71
1 4	2.821	*	*	*	1.71
1 5	2.196	*	*	*	1.71
1 6	1.446	*	*	*	1.71
PVO*PVIA					
1 1	350.4	*	*	*	2.57
1 2	374.5	*	*	*	2.57
1 3	326.3	*	*	*	2.57
1 4	180.8	*	*	*	2.57
1 5	-66.59	*	*	*	2.57
1 6	-398.1	*	*	*	2.57
2 1	512.1	*	*	*	2.57
2 2	452.7	*	*	*	2.57
2 3	331.9	*	*	*	2.57
2 4	142.4	*	*	*	2.57
2 5	-125.9	*	*	*	2.57
2 6	-469.9	*	*	*	2.57
3 1	-619.1	*	*	*	2.57
3 2	-524.5	*	*	*	2.57

3	3	-376.2	*	*	*	2.57
3	4	-122.2	*	*	*	2.57
3	5	171.9	*	*	*	2.57
3	6	531.9	*	*	*	2.57
PVT*PVO*PVIA						
1	1	1	-8.911	*	*	2.57
1	1	2	-11.29	*	*	2.57
1	1	3	-7.786	*	*	2.57
1	1	4	-4.036	*	*	2.57
1	1	5	5.089	*	*	2.57
1	1	6	11.84	*	*	2.57
1	2	1	-11.41	*	*	2.57
1	2	2	-4.286	*	*	2.57
1	2	3	1.714	*	*	2.57
1	2	4	2.464	*	*	2.57
1	2	5	2.589	*	*	2.57
1	2	6	3.839	*	*	2.57
1	3	1	7.161	*	*	2.57
1	3	2	6.286	*	*	2.57
1	3	3	2.286	*	*	2.57
1	3	4	4.536	*	*	2.57
1	3	5	-1.839	*	*	2.57
1	3	6	-7.589	*	*	2.57

Regression Equation

Quito = 14947 + 83.80 PVT_1 - 83.80 PVT_2 - 350.4 PVO_1 - 512.1 PVO_2
 + 619.1 PVO_3
 + 243.4 PVO_4 + 2036 PVIA_1 + 1840 PVIA_2 + 1314 PVIA_3
 + 501.7 PVIA_4 - 563.4 PVIA_5
 - 1851 PVIA_6 - 3278 PVIA_7 + 8.911 PVT*PVO_1 1 + 11.41 PVT*PVO_1
 2 - 7.161 PVT*PVO_1 3
 - 13.16 PVT*PVO_1 4 - 8.911 PVT*PVO_2 1 - 11.41 PVT*PVO_2 2
 + 7.161 PVT*PVO_2 3
 + 13.16 PVT*PVO_2 4 - 4.804 PVT*PVIA_1 1 - 2.429 PVT*PVIA_1 2
 + 1.571 PVT*PVIA_1 3
 + 2.821 PVT*PVIA_1 4 + 2.196 PVT*PVIA_1 5 + 1.446 PVT*PVIA_1 6
 - 0.8036 PVT*PVIA_1 7
 + 4.804 PVT*PVIA_2 1 + 2.429 PVT*PVIA_2 2 - 1.571 PVT*PVIA_2 3
 - 2.821 PVT*PVIA_2 4
 - 2.196 PVT*PVIA_2 5 - 1.446 PVT*PVIA_2 6 + 0.8036 PVT*PVIA_2 7
 + 350.4 PVO*PVIA_1 1
 + 374.5 PVO*PVIA_1 2 + 326.3 PVO*PVIA_1 3 + 180.8 PVO*PVIA_1 4
 - 66.59 PVO*PVIA_1 5
 - 398.1 PVO*PVIA_1 6 - 767.3 PVO*PVIA_1 7 + 512.1 PVO*PVIA_2 1
 + 452.7 PVO*PVIA_2 2
 + 331.9 PVO*PVIA_2 3 + 142.4 PVO*PVIA_2 4 - 125.9 PVO*PVIA_2 5
 - 469.9 PVO*PVIA_2 6
 - 843.2 PVO*PVIA_2 7 - 619.1 PVO*PVIA_3 1 - 524.5 PVO*PVIA_3 2
 - 376.2 PVO*PVIA_3 3
 - 122.2 PVO*PVIA_3 4 + 171.9 PVO*PVIA_3 5 + 531.9 PVO*PVIA_3 6
 + 938.2 PVO*PVIA_3 7
 - 243.4 PVO*PVIA_4 1 - 302.7 PVO*PVIA_4 2 - 282.0 PVO*PVIA_4 3
 - 201.0 PVO*PVIA_4 4
 + 20.63 PVO*PVIA_4 5 + 336.1 PVO*PVIA_4 6 + 672.4 PVO*PVIA_4 7
 - 8.911 PVT*PVO*PVIA_1 1

```

      1 - 11.29 PVT*PVO*PVIA_1 1 2 - 7.786 PVT*PVO*PVIA_1 1 3
- 4.036 PVT*PVO*PVIA_1 1 4
      + 5.089 PVT*PVO*PVIA_1 1 5 + 11.84 PVT*PVO*PVIA_1 1 6
+ 15.09 PVT*PVO*PVIA_1 1 7
      - 11.41 PVT*PVO*PVIA_1 2 1 - 4.286 PVT*PVO*PVIA_1 2 2
+ 1.714 PVT*PVO*PVIA_1 2 3
      + 2.464 PVT*PVO*PVIA_1 2 4 + 2.589 PVT*PVO*PVIA_1 2 5
+ 3.839 PVT*PVO*PVIA_1 2 6
      + 5.089 PVT*PVO*PVIA_1 2 7 + 7.161 PVT*PVO*PVIA_1 3 1
+ 6.286 PVT*PVO*PVIA_1 3 2
      + 2.286 PVT*PVO*PVIA_1 3 3 + 4.536 PVT*PVO*PVIA_1 3 4
- 1.839 PVT*PVO*PVIA_1 3 5
      - 7.589 PVT*PVO*PVIA_1 3 6 - 10.84 PVT*PVO*PVIA_1 3 7
+ 13.16 PVT*PVO*PVIA_1 4 1
      + 9.286 PVT*PVO*PVIA_1 4 2 + 3.786 PVT*PVO*PVIA_1 4 3
- 2.964 PVT*PVO*PVIA_1 4 4
      - 5.839 PVT*PVO*PVIA_1 4 5 - 8.089 PVT*PVO*PVIA_1 4 6
- 9.339 PVT*PVO*PVIA_1 4 7
      + 8.911 PVT*PVO*PVIA_2 1 1 + 11.29 PVT*PVO*PVIA_2 1 2
+ 7.786 PVT*PVO*PVIA_2 1 3
      + 4.036 PVT*PVO*PVIA_2 1 4 - 5.089 PVT*PVO*PVIA_2 1 5
- 11.84 PVT*PVO*PVIA_2 1 6
      - 15.09 PVT*PVO*PVIA_2 1 7 + 11.41 PVT*PVO*PVIA_2 2 1
+ 4.286 PVT*PVO*PVIA_2 2 2
      - 1.714 PVT*PVO*PVIA_2 2 3 - 2.464 PVT*PVO*PVIA_2 2 4
- 2.589 PVT*PVO*PVIA_2 2 5
      - 3.839 PVT*PVO*PVIA_2 2 6 - 5.089 PVT*PVO*PVIA_2 2 7
- 7.161 PVT*PVO*PVIA_2 3 1
      - 6.286 PVT*PVO*PVIA_2 3 2 - 2.286 PVT*PVO*PVIA_2 3 3
- 4.536 PVT*PVO*PVIA_2 3 4
      + 1.839 PVT*PVO*PVIA_2 3 5 + 7.589 PVT*PVO*PVIA_2 3 6
+ 10.84 PVT*PVO*PVIA_2 3 7
      - 13.16 PVT*PVO*PVIA_2 4 1 - 9.286 PVT*PVO*PVIA_2 4 2
- 3.786 PVT*PVO*PVIA_2 4 3
      + 2.964 PVT*PVO*PVIA_2 4 4 + 5.839 PVT*PVO*PVIA_2 4 5
+ 8.089 PVT*PVO*PVIA_2 4 6
      + 9.339 PVT*PVO*PVIA_2 4 7

```

* NOTE * Could not graph the specified residual type because MSE = 0 or the degrees of freedom for error = 0.

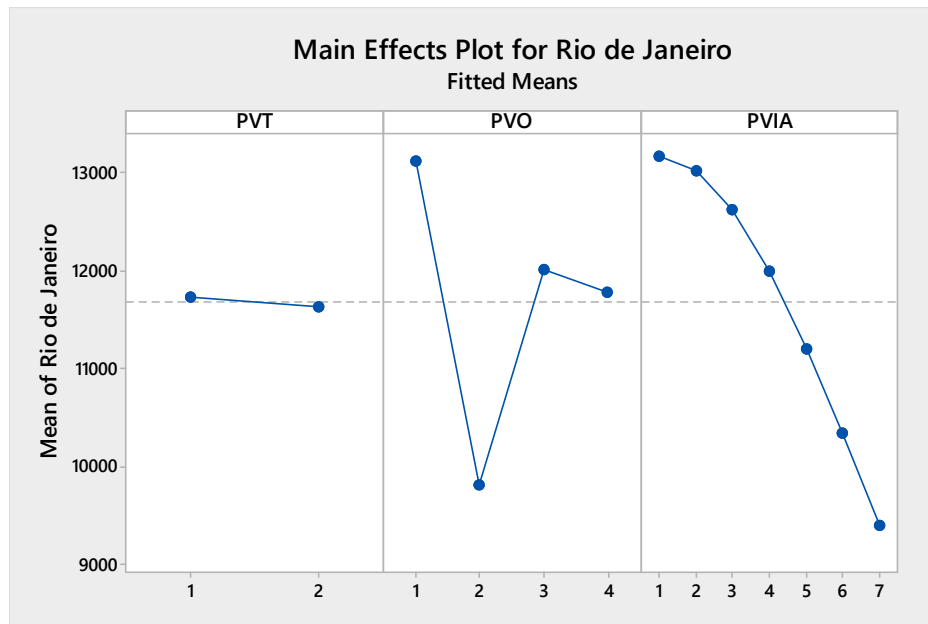


Figure S1. Main effects plot of installing PV modules on mounted roofs for Rio de Janeiro

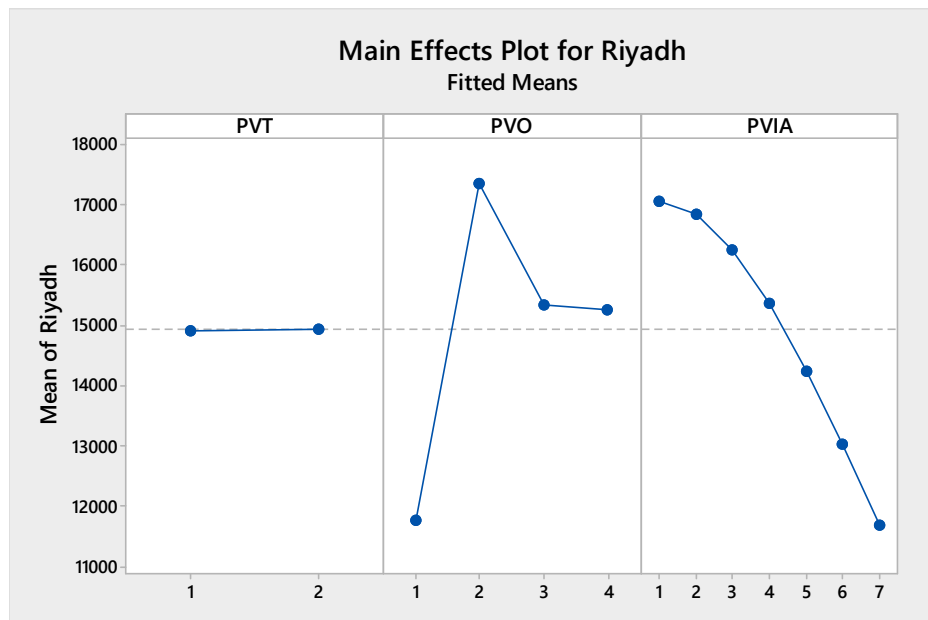


Figure S2. Main effects plot of installing PV modules on mounted roofs for Riyadh

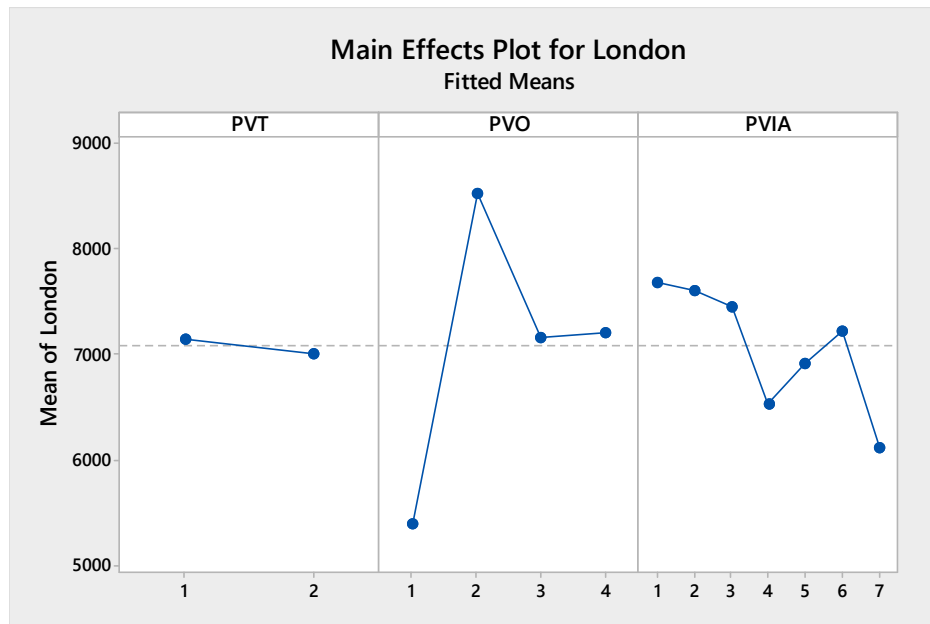


Figure S3. Main effects plot of installing PV modules on mounted roofs for London

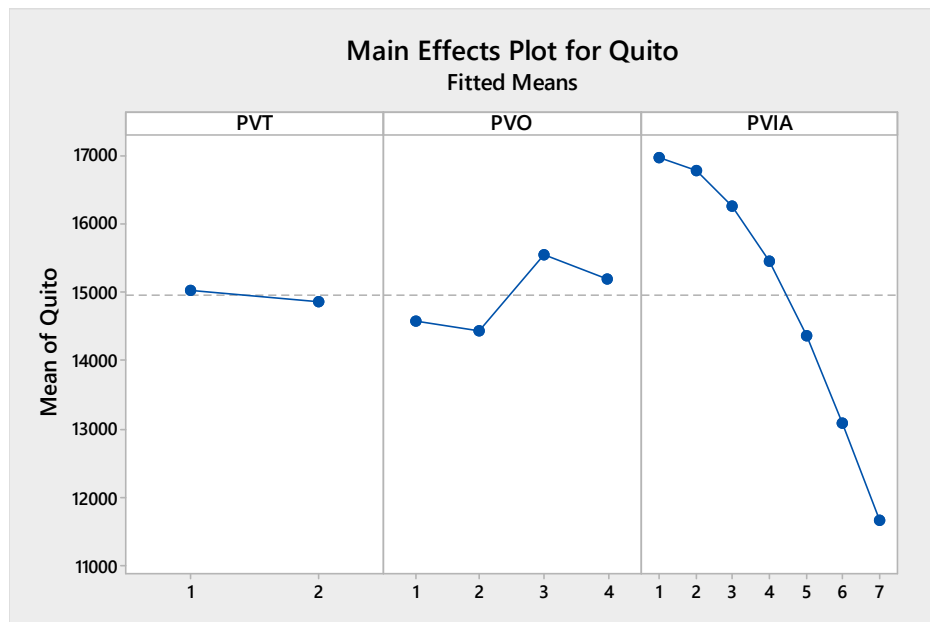


Figure S4. Main effects plot of installing PV modules on mounted roofs for Quito

Experimental design to install PV modules on elevations

Multilevel Factorial Design

Factors: 3 Replicates: 1
Base runs: 64 Total runs: 64
Base blocks: 1 Total blocks: 1

Number of levels: 2, 4, 8

General Factorial Regression: Rio de Janeiro versus PVT, PVO, PVIB

Factor Information

Factor	Levels	Values
PVT	2	1, 2
PVO	4	1, 2, 3, 4
PVIB	8	1, 2, 3, 4, 5, 6, 7, 8

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	63	414339448	6576817	*	*
Linear	11	385435544	35039595	*	*
PVT	1	122150	122150	*	*
PVO	3	92984570	30994857	*	*
PVIB	7	292328824	41761261	*	*
2-Way Interactions	31	28900587	932277	*	*
PVT*PVO	3	340	113	*	*
PVT*PVIB	7	163	23	*	*
PVO*PVIB	21	28900084	1376194	*	*
3-Way Interactions	21	3317	158	*	*
PVT*PVO*PVIB	21	3317	158	*	*
Error	0	*	*		
Total	63	414339448			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
*	100.00%	*	*

Coefficients

Term	Coef	SE	T-Value	P-Value	VIF
Constant	10997	*	*	*	
PVT					
1	43.69	*	*	*	1.00
PVO					
1	1373	*	*	*	1.50
2	-1935	*	*	*	1.50

3	391.1	*	*	*	1.50
PVIB					
1	2146	*	*	*	1.75
2	1996	*	*	*	1.75
3	1595	*	*	*	1.75
4	975.0	*	*	*	1.75
5	189.2	*	*	*	1.75
6	-666.1	*	*	*	1.75
7	-1609	*	*	*	1.75
PVT*PVO					
1 1	-0.8125	*	*	*	1.50
1 2	3.937	*	*	*	1.50
1 3	-1.250	*	*	*	1.50
PVT*PVIB					
1 1	-0.1875	*	*	*	1.75
1 2	-0.6875	*	*	*	1.75
1 3	-0.8125	*	*	*	1.75
1 4	-0.9375	*	*	*	1.75
1 5	-0.5625	*	*	*	1.75
1 6	1.437	*	*	*	1.75
1 7	3.562	*	*	*	1.75
PVO*PVIB					
1 1	-1373	*	*	*	2.63
1 2	-706.3	*	*	*	2.62
1 3	-115.7	*	*	*	2.62
1 4	367.2	*	*	*	2.63
1 5	705.1	*	*	*	2.63
1 6	803.3	*	*	*	2.62
1 7	710.5	*	*	*	2.63
2 1	1935	*	*	*	2.62
2 2	1247	*	*	*	2.62
2 3	542.0	*	*	*	2.63
2 4	-166.7	*	*	*	2.63
2 5	-778.3	*	*	*	2.63
2 6	-1095	*	*	*	2.63
2 7	-1200	*	*	*	2.62
3 1	-391.1	*	*	*	2.63
3 2	-335.1	*	*	*	2.63
3 3	-233.5	*	*	*	2.63
3 4	-77.59	*	*	*	2.63
3 5	87.28	*	*	*	2.63
3 6	206.5	*	*	*	2.62
3 7	313.2	*	*	*	2.62
PVT*PVO*PVIB					
1 1 1	0.8125	*	*	*	2.63
1 1 2	-5.688	*	*	*	2.63
1 1 3	-9.562	*	*	*	2.62
1 1 4	-8.437	*	*	*	2.63
1 1 5	-3.813	*	*	*	2.63
1 1 6	2.187	*	*	*	2.62
1 1 7	8.563	*	*	*	2.63
1 2 1	-3.938	*	*	*	2.63
1 2 2	3.562	*	*	*	2.62
1 2 3	10.19	*	*	*	2.62
1 2 4	10.81	*	*	*	2.63
1 2 5	6.938	*	*	*	2.62
1 2 6	2.437	*	*	*	2.62

1 2 7	-3.687	*	*	*	2.63
1 3 1	1.250	*	*	*	2.62
1 3 2	0.7500	*	*	*	2.63
1 3 3	-1.125	*	*	*	2.63
1 3 4	-2.000	*	*	*	2.62
1 3 5	-2.375	*	*	*	2.62
1 3 6	-2.375	*	*	*	2.62
1 3 7	-1.500	*	*	*	2.63

Regression Equation

Rio de Janeiro = 10997 + 43.69 PVT_1 - 43.69 PVT_2 + 1373 PVO_1
 - 1935 PVO_2 + 391.1 PVO_3 + 170.5 PVO_4
 + 2146 PVIB_1 + 1996 PVIB_2 + 1595 PVIB_3 + 975.0 PVIB_4
 + 189.2 PVIB_5 - 666.1 PVIB_6
 - 1609 PVIB_7 - 4625 PVIB_8 - 0.8125 PVT*PVO_1 1 + 3.937 PVT*PVO_1
 2 - 1.250 PVT*PVO_1 3
 - 1.875 PVT*PVO_1 4 + 0.8125 PVT*PVO_2 1 - 3.937 PVT*PVO_2 2
 + 1.250 PVT*PVO_2 3
 + 1.875 PVT*PVO_2 4 - 0.1875 PVT*PVIB_1 1 - 0.6875 PVT*PVIB_1 2
 - 0.8125 PVT*PVIB_1 3
 - 0.9375 PVT*PVIB_1 4 - 0.5625 PVT*PVIB_1 5 + 1.437 PVT*PVIB_1 6
 + 3.562 PVT*PVIB_1 7
 - 1.813 PVT*PVIB_1 8 + 0.1875 PVT*PVIB_2 1 + 0.6875 PVT*PVIB_2 2
 + 0.8125 PVT*PVIB_2 3
 + 0.9375 PVT*PVIB_2 4 + 0.5625 PVT*PVIB_2 5 - 1.437 PVT*PVIB_2 6
 - 3.562 PVT*PVIB_2 7
 + 1.813 PVT*PVIB_2 8 - 1373 PVO*PVIB_1 1 - 706.3 PVO*PVIB_1 2
 - 115.7 PVO*PVIB_1 3
 + 367.2 PVO*PVIB_1 4 + 705.1 PVO*PVIB_1 5 + 803.3 PVO*PVIB_1 6
 + 710.5 PVO*PVIB_1 7
 - 390.9 PVO*PVIB_1 8 + 1935 PVO*PVIB_2 1 + 1247 PVO*PVIB_2 2
 + 542.0 PVO*PVIB_2 3
 - 166.7 PVO*PVIB_2 4 - 778.3 PVO*PVIB_2 5 - 1095 PVO*PVIB_2 6
 - 1200 PVO*PVIB_2 7
 - 484.3 PVO*PVIB_2 8 - 391.1 PVO*PVIB_3 1 - 335.1 PVO*PVIB_3 2
 - 233.5 PVO*PVIB_3 3
 - 77.59 PVO*PVIB_3 4 + 87.28 PVO*PVIB_3 5 + 206.5 PVO*PVIB_3 6
 + 313.2 PVO*PVIB_3 7
 + 430.3 PVO*PVIB_3 8 - 170.5 PVO*PVIB_4 1 - 205.5 PVO*PVIB_4 2
 - 192.8 PVO*PVIB_4 3
 - 123.0 PVO*PVIB_4 4 - 14.09 PVO*PVIB_4 5 + 84.66 PVO*PVIB_4 6
 + 176.3 PVO*PVIB_4 7
 + 444.9 PVO*PVIB_4 8 + 0.8125 PVT*PVO*PVIB_1 1 1
 - 5.688 PVT*PVO*PVIB_1 1 2
 - 9.562 PVT*PVO*PVIB_1 1 3 - 8.437 PVT*PVO*PVIB_1 1 4
 - 3.813 PVT*PVO*PVIB_1 1 5
 + 2.187 PVT*PVO*PVIB_1 1 6 + 8.563 PVT*PVO*PVIB_1 1 7
 + 15.94 PVT*PVO*PVIB_1 1 8
 - 3.938 PVT*PVO*PVIB_1 2 1 + 3.562 PVT*PVO*PVIB_1 2 2
 + 10.19 PVT*PVO*PVIB_1 2 3
 + 10.81 PVT*PVO*PVIB_1 2 4 + 6.938 PVT*PVO*PVIB_1 2 5
 + 2.437 PVT*PVO*PVIB_1 2 6
 - 3.687 PVT*PVO*PVIB_1 2 7 - 26.31 PVT*PVO*PVIB_1 2 8
 + 1.250 PVT*PVO*PVIB_1 3 1

```

+ 0.7500 PVT*PVO*PVIB_1 3 2 - 1.125 PVT*PVO*PVIB_1 3 3
- 2.000 PVT*PVO*PVIB_1 3 4
- 2.375 PVT*PVO*PVIB_1 3 5 - 2.375 PVT*PVO*PVIB_1 3 6
- 1.500 PVT*PVO*PVIB_1 3 7
+ 7.375 PVT*PVO*PVIB_1 3 8 + 1.875 PVT*PVO*PVIB_1 4 1
+ 1.375 PVT*PVO*PVIB_1 4 2
+ 0.5000 PVT*PVO*PVIB_1 4 3 - 0.3750 PVT*PVO*PVIB_1 4 4
- 0.7500 PVT*PVO*PVIB_1 4 5
- 2.250 PVT*PVO*PVIB_1 4 6 - 3.375 PVT*PVO*PVIB_1 4 7
+ 3.000 PVT*PVO*PVIB_1 4 8
- 0.8125 PVT*PVO*PVIB_2 1 1 + 5.688 PVT*PVO*PVIB_2 1 2
+ 9.562 PVT*PVO*PVIB_2 1 3
+ 8.437 PVT*PVO*PVIB_2 1 4 + 3.813 PVT*PVO*PVIB_2 1 5
- 2.187 PVT*PVO*PVIB_2 1 6
- 8.563 PVT*PVO*PVIB_2 1 7 - 15.94 PVT*PVO*PVIB_2 1 8
+ 3.938 PVT*PVO*PVIB_2 2 1
- 3.562 PVT*PVO*PVIB_2 2 2 - 10.19 PVT*PVO*PVIB_2 2 3
- 10.81 PVT*PVO*PVIB_2 2 4
- 6.938 PVT*PVO*PVIB_2 2 5 - 2.437 PVT*PVO*PVIB_2 2 6
+ 3.687 PVT*PVO*PVIB_2 2 7
+ 26.31 PVT*PVO*PVIB_2 2 8 - 1.250 PVT*PVO*PVIB_2 3 1
- 0.7500 PVT*PVO*PVIB_2 3 2
+ 1.125 PVT*PVO*PVIB_2 3 3 + 2.000 PVT*PVO*PVIB_2 3 4
+ 2.375 PVT*PVO*PVIB_2 3 5
+ 2.375 PVT*PVO*PVIB_2 3 6 + 1.500 PVT*PVO*PVIB_2 3 7
- 7.375 PVT*PVO*PVIB_2 3 8
- 1.875 PVT*PVO*PVIB_2 4 1 - 1.375 PVT*PVO*PVIB_2 4 2
- 0.5000 PVT*PVO*PVIB_2 4 3
+ 0.3750 PVT*PVO*PVIB_2 4 4 + 0.7500 PVT*PVO*PVIB_2 4 5
+ 2.250 PVT*PVO*PVIB_2 4 6
+ 3.375 PVT*PVO*PVIB_2 4 7 - 3.000 PVT*PVO*PVIB_2 4 8

```

* NOTE * Could not graph the specified residual type because MSE = 0 or the degrees of freedom for error = 0.

General Factorial Regression: Riyadh versus PVT, PVO, PVIB

Factor Information

Factor	Levels	Values
PVT	2	1, 2
PVO	4	1, 2, 3, 4
PVIB	8	1, 2, 3, 4, 5, 6, 7, 8

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	63	871840268	13838734	*	*
Linear	11	790777213	71888838	*	*
PVT	1	644	644	*	*
PVO	3	257989023	85996341	*	*
PVIB	7	532787546	76112507	*	*
2-Way Interactions	31	81051547	2614566	*	*

PVT*PVO	3	7262	2421	*	*
PVT*PVIB	7	17359	2480	*	*
PVO*PVIB	21	81026927	3858425	*	*
3-Way Interactions	21	11508	548	*	*
PVT*PVO*PVIB	21	11508	548	*	*
Error	0	*	*		
Total	63	871840268			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
*	100.00%	*	*

Coefficients

Term	Coef	SE	T-Value	P-Value	VIF
Constant	13795	*	*	*	
PVT					
1	-3.172	*	*	*	1.00
PVO					
1	-3228	*	*	*	1.50
2	2295	*	*	*	1.50
3	499.2	*	*	*	1.50
PVIB					
1	2906	*	*	*	1.75
2	2695	*	*	*	1.75
3	2115	*	*	*	1.75
4	1528	*	*	*	1.75
5	139.0	*	*	*	1.75
6	-1058	*	*	*	1.75
7	-2123	*	*	*	1.75
PVT*PVO					
1 1	16.30	*	*	*	1.50
1 2	-10.27	*	*	*	1.50
1 3	2.672	*	*	*	1.50
PVT*PVIB					
1 1	-13.33	*	*	*	1.75
1 2	-12.58	*	*	*	1.75
1 3	-11.33	*	*	*	1.75
1 4	-15.20	*	*	*	1.75
1 5	-2.703	*	*	*	1.75
1 6	6.422	*	*	*	1.75
1 7	13.42	*	*	*	1.75
PVO*PVIB					
1 1	3228	*	*	*	2.63
1 2	2089	*	*	*	2.62
1 3	924.4	*	*	*	2.62
1 4	-305.2	*	*	*	2.63
1 5	-1217	*	*	*	2.63
1 6	-1764	*	*	*	2.62
1 7	-2101	*	*	*	2.63
2 1	-2295	*	*	*	2.62
2 2	-1194	*	*	*	2.62
2 3	-212.9	*	*	*	2.63

2 4	637.0	*	*	*	2.63
2 5	1139	*	*	*	2.63
2 6	1338	*	*	*	2.63
2 7	1263	*	*	*	2.62
3 1	-499.2	*	*	*	2.63
3 2	-465.0	*	*	*	2.63
3 3	-357.5	*	*	*	2.63
3 4	-158.6	*	*	*	2.63
3 5	63.67	*	*	*	2.63
3 6	236.3	*	*	*	2.62
3 7	438.0	*	*	*	2.62
PVT*PVO*PVIB					
1 1 1	-16.30	*	*	*	2.63
1 1 2	1.453	*	*	*	2.63
1 1 3	14.70	*	*	*	2.62
1 1 4	23.08	*	*	*	2.63
1 1 5	14.58	*	*	*	2.63
1 1 6	7.953	*	*	*	2.62
1 1 7	-0.04687	*	*	*	2.63
1 2 1	10.27	*	*	*	2.63
1 2 2	-5.484	*	*	*	2.62
1 2 3	-15.23	*	*	*	2.62
1 2 4	-20.36	*	*	*	2.63
1 2 5	-10.86	*	*	*	2.62
1 2 6	-0.4844	*	*	*	2.62
1 2 7	9.516	*	*	*	2.63
1 3 1	-2.672	*	*	*	2.62
1 3 2	-1.422	*	*	*	2.63
1 3 3	-1.172	*	*	*	2.63
1 3 4	-1.297	*	*	*	2.62
1 3 5	-0.2969	*	*	*	2.62
1 3 6	-0.9219	*	*	*	2.62
1 3 7	-1.422	*	*	*	2.63

Regression Equation

Riyadh = 13795 - 3.172 PVT_1 + 3.172 PVT_2 - 3228 PVO_1 + 2295 PVO_2
 + 499.2 PVO_3 + 434.3 PVO_4
 + 2906 PVIB_1 + 2695 PVIB_2 + 2115 PVIB_3 + 1528 PVIB_4
 + 139.0 PVIB_5 - 1058 PVIB_6
 - 2123 PVIB_7 - 6200 PVIB_8 + 16.30 PVT*PVO_1 1 - 10.27 PVT*PVO_1
 2 + 2.672 PVT*PVO_1 3
 - 8.703 PVT*PVO_1 4 - 16.30 PVT*PVO_2 1 + 10.27 PVT*PVO_2 2
 - 2.672 PVT*PVO_2 3
 + 8.703 PVT*PVO_2 4 - 13.33 PVT*PVIB_1 1 - 12.58 PVT*PVIB_1 2
 - 11.33 PVT*PVIB_1 3
 - 15.20 PVT*PVIB_1 4 - 2.703 PVT*PVIB_1 5 + 6.422 PVT*PVIB_1 6
 + 13.42 PVT*PVIB_1 7
 + 35.30 PVT*PVIB_1 8 + 13.33 PVT*PVIB_2 1 + 12.58 PVT*PVIB_2 2
 + 11.33 PVT*PVIB_2 3
 + 15.20 PVT*PVIB_2 4 + 2.703 PVT*PVIB_2 5 - 6.422 PVT*PVIB_2 6
 - 13.42 PVT*PVIB_2 7
 - 35.30 PVT*PVIB_2 8 + 3228 PVO*PVIB_1 1 + 2089 PVO*PVIB_1 2
 + 924.4 PVO*PVIB_1 3
 - 305.2 PVO*PVIB_1 4 - 1217 PVO*PVIB_1 5 - 1764 PVO*PVIB_1 6
 - 2101 PVO*PVIB_1 7

- 854.5 PVO*PVIB_1 8 - 2295 PVO*PVIB_2 1 - 1194 PVO*PVIB_2 2
 - 212.9 PVO*PVIB_2 3
 + 637.0 PVO*PVIB_2 4 + 1139 PVO*PVIB_2 5 + 1338 PVO*PVIB_2 6
 + 1263 PVO*PVIB_2 7
 - 674.8 PVO*PVIB_2 8 - 499.2 PVO*PVIB_3 1 - 465.0 PVO*PVIB_3 2
 - 357.5 PVO*PVIB_3 3
 - 158.6 PVO*PVIB_3 4 + 63.67 PVO*PVIB_3 5 + 236.3 PVO*PVIB_3 6
 + 438.0 PVO*PVIB_3 7
 + 742.2 PVO*PVIB_3 8 - 434.3 PVO*PVIB_4 1 - 429.6 PVO*PVIB_4 2
 - 354.1 PVO*PVIB_4 3
 - 173.2 PVO*PVIB_4 4 + 15.05 PVO*PVIB_4 5 + 189.2 PVO*PVIB_4 6
 + 399.9 PVO*PVIB_4 7
 + 787.0 PVO*PVIB_4 8 - 16.30 PVT*PVO*PVIB_1 1 1
 + 1.453 PVT*PVO*PVIB_1 1 2
 + 14.70 PVT*PVO*PVIB_1 1 3 + 23.08 PVT*PVO*PVIB_1 1 4
 + 14.58 PVT*PVO*PVIB_1 1 5
 + 7.953 PVT*PVO*PVIB_1 1 6 - 0.04687 PVT*PVO*PVIB_1 1 7
 - 45.42 PVT*PVO*PVIB_1 1 8
 + 10.27 PVT*PVO*PVIB_1 2 1 - 5.484 PVT*PVO*PVIB_1 2 2
 - 15.23 PVT*PVO*PVIB_1 2 3
 - 20.36 PVT*PVO*PVIB_1 2 4 - 10.86 PVT*PVO*PVIB_1 2 5
 - 0.4844 PVT*PVO*PVIB_1 2 6
 + 9.516 PVT*PVO*PVIB_1 2 7 + 32.64 PVT*PVO*PVIB_1 2 8
 - 2.672 PVT*PVO*PVIB_1 3 1
 - 1.422 PVT*PVO*PVIB_1 3 2 - 1.172 PVT*PVO*PVIB_1 3 3
 - 1.297 PVT*PVO*PVIB_1 3 4
 - 0.2969 PVT*PVO*PVIB_1 3 5 - 0.9219 PVT*PVO*PVIB_1 3 6
 - 1.422 PVT*PVO*PVIB_1 3 7
 + 9.203 PVT*PVO*PVIB_1 3 8 + 8.703 PVT*PVO*PVIB_1 4 1
 + 5.453 PVT*PVO*PVIB_1 4 2
 + 1.703 PVT*PVO*PVIB_1 4 3 - 1.422 PVT*PVO*PVIB_1 4 4
 - 3.422 PVT*PVO*PVIB_1 4 5
 - 6.547 PVT*PVO*PVIB_1 4 6 - 8.047 PVT*PVO*PVIB_1 4 7
 + 3.578 PVT*PVO*PVIB_1 4 8
 + 16.30 PVT*PVO*PVIB_2 1 1 - 1.453 PVT*PVO*PVIB_2 1 2
 - 14.70 PVT*PVO*PVIB_2 1 3
 - 23.08 PVT*PVO*PVIB_2 1 4 - 14.58 PVT*PVO*PVIB_2 1 5
 - 7.953 PVT*PVO*PVIB_2 1 6
 + 0.04687 PVT*PVO*PVIB_2 1 7 + 45.42 PVT*PVO*PVIB_2 1 8
 - 10.27 PVT*PVO*PVIB_2 2 1
 + 5.484 PVT*PVO*PVIB_2 2 2 + 15.23 PVT*PVO*PVIB_2 2 3
 + 20.36 PVT*PVO*PVIB_2 2 4
 + 10.86 PVT*PVO*PVIB_2 2 5 + 0.4844 PVT*PVO*PVIB_2 2 6
 - 9.516 PVT*PVO*PVIB_2 2 7
 - 32.64 PVT*PVO*PVIB_2 2 8 + 2.672 PVT*PVO*PVIB_2 3 1
 + 1.422 PVT*PVO*PVIB_2 3 2
 + 1.172 PVT*PVO*PVIB_2 3 3 + 1.297 PVT*PVO*PVIB_2 3 4
 + 0.2969 PVT*PVO*PVIB_2 3 5
 + 0.9219 PVT*PVO*PVIB_2 3 6 + 1.422 PVT*PVO*PVIB_2 3 7
 - 9.203 PVT*PVO*PVIB_2 3 8
 - 8.703 PVT*PVO*PVIB_2 4 1 - 5.453 PVT*PVO*PVIB_2 4 2
 - 1.703 PVT*PVO*PVIB_2 4 3
 + 1.422 PVT*PVO*PVIB_2 4 4 + 3.422 PVT*PVO*PVIB_2 4 5
 + 6.547 PVT*PVO*PVIB_2 4 6
 + 8.047 PVT*PVO*PVIB_2 4 7 - 3.578 PVT*PVO*PVIB_2 4 8

* NOTE * Could not graph the specified residual type because MSE = 0 or the degrees of freedom for error = 0.

General Factorial Regression: London versus PVT, PVO, PVIB

Factor Information

Factor	Levels	Values
PVT	2	1, 2
PVO	4	1, 2, 3, 4
PVIB	8	1, 2, 3, 4, 5, 6, 7, 8

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	63	164663356	2613704	*	*
Linear	11	142427719	12947974	*	*
PVT	1	246636	246636	*	*
PVO	3	82326919	27442306	*	*
PVIB	7	59854163	8550595	*	*
2-Way Interactions	31	22232825	717188	*	*
PVT*PVO	3	4134	1378	*	*
PVT*PVIB	7	9930	1419	*	*
PVO*PVIB	21	22218760	1058036	*	*
3-Way Interactions	21	2812	134	*	*
PVT*PVO*PVIB	21	2812	134	*	*
Error	0	*	*		
Total	63	164663356			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
*	100.00%	*	*

Coefficients

Term	Coef	SE	T-Value	P-Value	VIF
Constant	6752	*	*	*	
PVT					
1	62.08	*	*	*	1.00
PVO					
1	-1721	*	*	*	1.50
2	1467	*	*	*	1.50
3	101.9	*	*	*	1.50
PVIB					
1	914.7	*	*	*	1.75
2	848.1	*	*	*	1.75
3	689.5	*	*	*	1.75
4	-229.8	*	*	*	1.75
5	149.4	*	*	*	1.75

6	454.1	*	*	*	1.75
7	-646.3	*	*	*	1.75
PVT*PVO					
1 1	-12.58	*	*	*	1.50
1 2	9.609	*	*	*	1.50
1 3	2.797	*	*	*	1.50
PVT*PVIB					
1 1	14.92	*	*	*	1.75
1 2	13.05	*	*	*	1.75
1 3	9.422	*	*	*	1.75
1 4	-6.328	*	*	*	1.75
1 5	-0.7031	*	*	*	1.75
1 6	4.797	*	*	*	1.75
1 7	-11.33	*	*	*	1.75
PVO*PVIB					
1 1	1721	*	*	*	2.63
1 2	1009	*	*	*	2.62
1 3	365.3	*	*	*	2.62
1 4	-945.5	*	*	*	2.63
1 5	-643.1	*	*	*	2.63
1 6	-201.4	*	*	*	2.62
1 7	-1016	*	*	*	2.63
2 1	-1467	*	*	*	2.62
2 2	-780.8	*	*	*	2.62
2 3	-201.7	*	*	*	2.63
2 4	759.6	*	*	*	2.63
2 5	581.0	*	*	*	2.63
2 6	260.7	*	*	*	2.63
2 7	772.6	*	*	*	2.62
3 1	-101.9	*	*	*	2.63
3 2	-102.7	*	*	*	2.63
3 3	-79.11	*	*	*	2.63
3 4	84.14	*	*	*	2.63
3 5	25.02	*	*	*	2.63
3 6	-32.23	*	*	*	2.62
3 7	112.6	*	*	*	2.62
PVT*PVO*PVIB					
1 1 1	12.58	*	*	*	2.63
1 1 2	9.953	*	*	*	2.63
1 1 3	8.578	*	*	*	2.62
1 1 4	-6.672	*	*	*	2.63
1 1 5	0.2031	*	*	*	2.63
1 1 6	5.203	*	*	*	2.62
1 1 7	-12.17	*	*	*	2.63
1 2 1	-9.609	*	*	*	2.63
1 2 2	-7.234	*	*	*	2.62
1 2 3	-6.109	*	*	*	2.62
1 2 4	3.641	*	*	*	2.63
1 2 5	-0.4844	*	*	*	2.62
1 2 6	-3.484	*	*	*	2.62
1 2 7	8.141	*	*	*	2.63
1 3 1	-2.797	*	*	*	2.62
1 3 2	-2.422	*	*	*	2.63
1 3 3	-1.797	*	*	*	2.63
1 3 4	1.953	*	*	*	2.62
1 3 5	0.3281	*	*	*	2.62
1 3 6	-0.6719	*	*	*	2.62

1 3 7 2.953 * * * 2.63

Regression Equation

London = 6752 + 62.08 PVT_1 - 62.08 PVT_2 - 1721 PVO_1 + 1467 PVO_2
+ 101.9 PVO_3 + 151.7 PVO_4
+ 914.7 PVIB_1 + 848.1 PVIB_2 + 689.5 PVIB_3 - 229.8 PVIB_4
+ 149.4 PVIB_5
+ 454.1 PVIB_6 - 646.3 PVIB_7 - 2180 PVIB_8 - 12.58 PVT*PVO_1 1
+ 9.609 PVT*PVO_1 2
+ 2.797 PVT*PVO_1 3 + 0.1719 PVT*PVO_1 4 + 12.58 PVT*PVO_2 1
- 9.609 PVT*PVO_2 2
- 2.797 PVT*PVO_2 3 - 0.1719 PVT*PVO_2 4 + 14.92 PVT*PVIB_1 1
+ 13.05 PVT*PVIB_1 2
+ 9.422 PVT*PVIB_1 3 - 6.328 PVT*PVIB_1 4 - 0.7031 PVT*PVIB_1 5
+ 4.797 PVT*PVIB_1 6
- 11.33 PVT*PVIB_1 7 - 23.83 PVT*PVIB_1 8 - 14.92 PVT*PVIB_2 1
- 13.05 PVT*PVIB_2 2
- 9.422 PVT*PVIB_2 3 + 6.328 PVT*PVIB_2 4 + 0.7031 PVT*PVIB_2 5
- 4.797 PVT*PVIB_2 6
+ 11.33 PVT*PVIB_2 7 + 23.83 PVT*PVIB_2 8 + 1721 PVO*PVIB_1 1
+ 1009 PVO*PVIB_1 2
+ 365.3 PVO*PVIB_1 3 - 945.5 PVO*PVIB_1 4 - 643.1 PVO*PVIB_1 5
- 201.4 PVO*PVIB_1 6
- 1016 PVO*PVIB_1 7 - 288.0 PVO*PVIB_1 8 - 1467 PVO*PVIB_2 1
- 780.8 PVO*PVIB_2 2
- 201.7 PVO*PVIB_2 3 + 759.6 PVO*PVIB_2 4 + 581.0 PVO*PVIB_2 5
+ 260.7 PVO*PVIB_2 6
+ 772.6 PVO*PVIB_2 7 + 75.58 PVO*PVIB_2 8 - 101.9 PVO*PVIB_3 1
- 102.7 PVO*PVIB_3 2
- 79.11 PVO*PVIB_3 3 + 84.14 PVO*PVIB_3 4 + 25.02 PVO*PVIB_3 5
- 32.23 PVO*PVIB_3 6
+ 112.6 PVO*PVIB_3 7 + 94.14 PVO*PVIB_3 8 - 151.7 PVO*PVIB_4 1
- 125.1 PVO*PVIB_4 2
- 84.48 PVO*PVIB_4 3 + 101.8 PVO*PVIB_4 4 + 37.14 PVO*PVIB_4 5
- 27.11 PVO*PVIB_4 6
+ 131.3 PVO*PVIB_4 7 + 118.3 PVO*PVIB_4 8 + 12.58 PVT*PVO*PVIB_1
1 1
+ 9.953 PVT*PVO*PVIB_1 1 2 + 8.578 PVT*PVO*PVIB_1 1 3
- 6.672 PVT*PVO*PVIB_1 1 4
+ 0.2031 PVT*PVO*PVIB_1 1 5 + 5.203 PVT*PVO*PVIB_1 1 6
- 12.17 PVT*PVO*PVIB_1 1 7
- 17.67 PVT*PVO*PVIB_1 1 8 - 9.609 PVT*PVO*PVIB_1 2 1
- 7.234 PVT*PVO*PVIB_1 2 2
- 6.109 PVT*PVO*PVIB_1 2 3 + 3.641 PVT*PVO*PVIB_1 2 4
- 0.4844 PVT*PVO*PVIB_1 2 5
- 3.484 PVT*PVO*PVIB_1 2 6 + 8.141 PVT*PVO*PVIB_1 2 7
+ 15.14 PVT*PVO*PVIB_1 2 8
- 2.797 PVT*PVO*PVIB_1 3 1 - 2.422 PVT*PVO*PVIB_1 3 2
- 1.797 PVT*PVO*PVIB_1 3 3
+ 1.953 PVT*PVO*PVIB_1 3 4 + 0.3281 PVT*PVO*PVIB_1 3 5
- 0.6719 PVT*PVO*PVIB_1 3 6
+ 2.953 PVT*PVO*PVIB_1 3 7 + 2.453 PVT*PVO*PVIB_1 3 8
- 0.1719 PVT*PVO*PVIB_1 4 1
- 0.2969 PVT*PVO*PVIB_1 4 2 - 0.6719 PVT*PVO*PVIB_1 4 3
+ 1.078 PVT*PVO*PVIB_1 4 4

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- 0.04688 PVT*PVO*PVIB_1 4 5 - 1.047 PVT*PVO*PVIB_1 4 6
+ 1.078 PVT*PVO*PVIB_1 4 7
+ 0.07813 PVT*PVO*PVIB_1 4 8 - 12.58 PVT*PVO*PVIB_2 1 1
- 9.953 PVT*PVO*PVIB_2 1 2
- 8.578 PVT*PVO*PVIB_2 1 3 + 6.672 PVT*PVO*PVIB_2 1 4
- 0.2031 PVT*PVO*PVIB_2 1 5
- 5.203 PVT*PVO*PVIB_2 1 6 + 12.17 PVT*PVO*PVIB_2 1 7
+ 17.67 PVT*PVO*PVIB_2 1 8
+ 9.609 PVT*PVO*PVIB_2 2 1 + 7.234 PVT*PVO*PVIB_2 2 2
+ 6.109 PVT*PVO*PVIB_2 2 3
- 3.641 PVT*PVO*PVIB_2 2 4 + 0.4844 PVT*PVO*PVIB_2 2 5
+ 3.484 PVT*PVO*PVIB_2 2 6
- 8.141 PVT*PVO*PVIB_2 2 7 - 15.14 PVT*PVO*PVIB_2 2 8
+ 2.797 PVT*PVO*PVIB_2 3 1
+ 2.422 PVT*PVO*PVIB_2 3 2 + 1.797 PVT*PVO*PVIB_2 3 3
- 1.953 PVT*PVO*PVIB_2 3 4
- 0.3281 PVT*PVO*PVIB_2 3 5 + 0.6719 PVT*PVO*PVIB_2 3 6
- 2.953 PVT*PVO*PVIB_2 3 7
- 2.453 PVT*PVO*PVIB_2 3 8 + 0.1719 PVT*PVO*PVIB_2 4 1
+ 0.2969 PVT*PVO*PVIB_2 4 2
+ 0.6719 PVT*PVO*PVIB_2 4 3 - 1.078 PVT*PVO*PVIB_2 4 4
+ 0.04688 PVT*PVO*PVIB_2 4 5
+ 1.047 PVT*PVO*PVIB_2 4 6 - 1.078 PVT*PVO*PVIB_2 4 7
- 0.07813 PVT*PVO*PVIB_2 4 8

```

* NOTE * Could not graph the specified residual type because MSE = 0 or the degrees of freedom for error = 0.

General Factorial Regression: Quito versus PVT, PVO, PVIB

Factor Information

Factor	Levels	Values
PVT	2	1, 2
PVO	4	1, 2, 3, 4
PVIB	8	1, 2, 3, 4, 5, 6, 7, 8

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	63	571329712	9068726	*	*
Linear	11	549899587	49990872	*	*
PVT	1	393129	393129	*	*
PVO	3	22971957	7657319	*	*
PVIB	7	526534500	75219214	*	*
2-Way Interactions	31	21426239	691169	*	*
PVT*PVO	3	6086	2029	*	*
PVT*PVIB	7	1030	147	*	*
PVO*PVIB	21	21419122	1019958	*	*
3-Way Interactions	21	3886	185	*	*
PVT*PVO*PVIB	21	3886	185	*	*
Error	0	*	*		
Total	63	571329712			

Model Summary

S R-sq R-sq(adj) R-sq(pred)
 * 100.00% * *

Coefficients

Term	Coef	SE	T-Value	P-Value	VIF
Constant	13825	*	*	*	
PVT					
1	78.37	*	*	*	1.00
PVO					
1	-504.9	*	*	*	1.50
2	-658.2	*	*	*	1.50
3	770.2	*	*	*	1.50
PVIB					
1	2811	*	*	*	1.75
2	2620	*	*	*	1.75
3	2105	*	*	*	1.75
4	1586	*	*	*	1.75
5	255.4	*	*	*	1.75
6	-1009	*	*	*	1.75
7	-2181	*	*	*	1.75
PVT*PVO					
1 1	9.437	*	*	*	1.50
1 2	9.750	*	*	*	1.50
1 3	-7.125	*	*	*	1.50
PVT*PVIB					
1 1	-5.375	*	*	*	1.75
1 2	-4.375	*	*	*	1.75
1 3	-0.8750	*	*	*	1.75
1 4	3.750	*	*	*	1.75
1 5	4.750	*	*	*	1.75
1 6	4.500	*	*	*	1.75
1 7	2.000	*	*	*	1.75
PVO*PVIB					
1 1	504.9	*	*	*	2.63
1 2	523.7	*	*	*	2.62
1 3	474.2	*	*	*	2.62
1 4	334.8	*	*	*	2.63
1 5	86.03	*	*	*	2.63
1 6	-236.2	*	*	*	2.62
1 7	-607.2	*	*	*	2.63
2 1	658.2	*	*	*	2.62
2 2	601.5	*	*	*	2.62
2 3	484.5	*	*	*	2.63
2 4	290.6	*	*	*	2.63
2 5	29.34	*	*	*	2.63
2 6	-310.4	*	*	*	2.63
2 7	-691.4	*	*	*	2.62
3 1	-770.2	*	*	*	2.63
3 2	-670.9	*	*	*	2.63
3 3	-522.4	*	*	*	2.63

3 4	-272.8	*	*	*	2.63
3 5	21.97	*	*	*	2.63
3 6	371.7	*	*	*	2.62
3 7	781.2	*	*	*	2.62
PVT*PVO*PVIB					
1 1 1	-9.438	*	*	*	2.63
1 1 2	-9.438	*	*	*	2.63
1 1 3	-7.437	*	*	*	2.62
1 1 4	-4.063	*	*	*	2.63
1 1 5	6.437	*	*	*	2.63
1 1 6	12.69	*	*	*	2.62
1 1 7	15.19	*	*	*	2.63
1 2 1	-9.750	*	*	*	2.63
1 2 2	-4.250	*	*	*	2.62
1 2 3	1.250	*	*	*	2.62
1 2 4	4.125	*	*	*	2.63
1 2 5	4.125	*	*	*	2.62
1 2 6	5.875	*	*	*	2.62
1 2 7	7.375	*	*	*	2.63
1 3 1	7.125	*	*	*	2.62
1 3 2	4.625	*	*	*	2.63
1 3 3	1.625	*	*	*	2.63
1 3 4	4.000	*	*	*	2.62
1 3 5	-3.000	*	*	*	2.62
1 3 6	-8.750	*	*	*	2.62
1 3 7	-11.75	*	*	*	2.63

Regression Equation

Quito = 13825 + 78.37 PVT_1 - 78.37 PVT_2 - 504.9 PVO_1 - 658.2 PVO_2
 + 770.2 PVO_3
 + 393.0 PVO_4 + 2811 PVIB_1 + 2620 PVIB_2 + 2105 PVIB_3
 + 1586 PVIB_4 + 255.4 PVIB_5
 - 1009 PVIB_6 - 2181 PVIB_7 - 6186 PVIB_8 + 9.437 PVT*PVO_1 1
 + 9.750 PVT*PVO_1 2
 - 7.125 PVT*PVO_1 3 - 12.06 PVT*PVO_1 4 - 9.437 PVT*PVO_2 1
 - 9.750 PVT*PVO_2 2
 + 7.125 PVT*PVO_2 3 + 12.06 PVT*PVO_2 4 - 5.375 PVT*PVIB_1 1
 - 4.375 PVT*PVIB_1 2
 - 0.8750 PVT*PVIB_1 3 + 3.750 PVT*PVIB_1 4 + 4.750 PVT*PVIB_1 5
 + 4.500 PVT*PVIB_1 6
 + 2.000 PVT*PVIB_1 7 - 4.375 PVT*PVIB_1 8 + 5.375 PVT*PVIB_2 1
 + 4.375 PVT*PVIB_2 2
 + 0.8750 PVT*PVIB_2 3 - 3.750 PVT*PVIB_2 4 - 4.750 PVT*PVIB_2 5
 - 4.500 PVT*PVIB_2 6
 - 2.000 PVT*PVIB_2 7 + 4.375 PVT*PVIB_2 8 + 504.9 PVO*PVIB_1 1
 + 523.7 PVO*PVIB_1 2
 + 474.2 PVO*PVIB_1 3 + 334.8 PVO*PVIB_1 4 + 86.03 PVO*PVIB_1 5
 - 236.2 PVO*PVIB_1 6
 - 607.2 PVO*PVIB_1 7 - 1080 PVO*PVIB_1 8 + 658.2 PVO*PVIB_2 1
 + 601.5 PVO*PVIB_2 2
 + 484.5 PVO*PVIB_2 3 + 290.6 PVO*PVIB_2 4 + 29.34 PVO*PVIB_2 5
 - 310.4 PVO*PVIB_2 6
 - 691.4 PVO*PVIB_2 7 - 1062 PVO*PVIB_2 8 - 770.2 PVO*PVIB_3 1
 - 670.9 PVO*PVIB_3 2

```

- 522.4 PVO*PVIB_3 3 - 272.8 PVO*PVIB_3 4 + 21.97 PVO*PVIB_3 5
+ 371.7 PVO*PVIB_3 6
+ 781.2 PVO*PVIB_3 7 + 1061 PVO*PVIB_3 8 - 393.0 PVO*PVIB_4 1
- 454.2 PVO*PVIB_4 2
- 436.2 PVO*PVIB_4 3 - 352.6 PVO*PVIB_4 4 - 137.3 PVO*PVIB_4 5
+ 174.9 PVO*PVIB_4 6
+ 517.4 PVO*PVIB_4 7 + 1081 PVO*PVIB_4 8 - 9.438 PVT*PVO*PVIB_1 1
1
- 9.438 PVT*PVO*PVIB_1 1 2 - 7.437 PVT*PVO*PVIB_1 1 3
- 4.063 PVT*PVO*PVIB_1 1 4
+ 6.437 PVT*PVO*PVIB_1 1 5 + 12.69 PVT*PVO*PVIB_1 1 6
+ 15.19 PVT*PVO*PVIB_1 1 7
- 3.937 PVT*PVO*PVIB_1 1 8 - 9.750 PVT*PVO*PVIB_1 2 1
- 4.250 PVT*PVO*PVIB_1 2 2
+ 1.250 PVT*PVO*PVIB_1 2 3 + 4.125 PVT*PVO*PVIB_1 2 4
+ 4.125 PVT*PVO*PVIB_1 2 5
+ 5.875 PVT*PVO*PVIB_1 2 6 + 7.375 PVT*PVO*PVIB_1 2 7
- 8.750 PVT*PVO*PVIB_1 2 8
+ 7.125 PVT*PVO*PVIB_1 3 1 + 4.625 PVT*PVO*PVIB_1 3 2
+ 1.625 PVT*PVO*PVIB_1 3 3
+ 4.000 PVT*PVO*PVIB_1 3 4 - 3.000 PVT*PVO*PVIB_1 3 5
- 8.750 PVT*PVO*PVIB_1 3 6
- 11.75 PVT*PVO*PVIB_1 3 7 + 6.125 PVT*PVO*PVIB_1 3 8
+ 12.06 PVT*PVO*PVIB_1 4 1
+ 9.063 PVT*PVO*PVIB_1 4 2 + 4.562 PVT*PVO*PVIB_1 4 3
- 4.063 PVT*PVO*PVIB_1 4 4
- 7.563 PVT*PVO*PVIB_1 4 5 - 9.813 PVT*PVO*PVIB_1 4 6
- 10.81 PVT*PVO*PVIB_1 4 7
+ 6.563 PVT*PVO*PVIB_1 4 8 + 9.438 PVT*PVO*PVIB_2 1 1
+ 9.438 PVT*PVO*PVIB_2 1 2
+ 7.437 PVT*PVO*PVIB_2 1 3 + 4.063 PVT*PVO*PVIB_2 1 4
- 6.437 PVT*PVO*PVIB_2 1 5
- 12.69 PVT*PVO*PVIB_2 1 6 - 15.19 PVT*PVO*PVIB_2 1 7
+ 3.937 PVT*PVO*PVIB_2 1 8
+ 9.750 PVT*PVO*PVIB_2 2 1 + 4.250 PVT*PVO*PVIB_2 2 2
- 1.250 PVT*PVO*PVIB_2 2 3
- 4.125 PVT*PVO*PVIB_2 2 4 - 4.125 PVT*PVO*PVIB_2 2 5
- 5.875 PVT*PVO*PVIB_2 2 6
- 7.375 PVT*PVO*PVIB_2 2 7 + 8.750 PVT*PVO*PVIB_2 2 8
- 7.125 PVT*PVO*PVIB_2 3 1
- 4.625 PVT*PVO*PVIB_2 3 2 - 1.625 PVT*PVO*PVIB_2 3 3
- 4.000 PVT*PVO*PVIB_2 3 4
+ 3.000 PVT*PVO*PVIB_2 3 5 + 8.750 PVT*PVO*PVIB_2 3 6
+ 11.75 PVT*PVO*PVIB_2 3 7
- 6.125 PVT*PVO*PVIB_2 3 8 - 12.06 PVT*PVO*PVIB_2 4 1
- 9.063 PVT*PVO*PVIB_2 4 2
- 4.562 PVT*PVO*PVIB_2 4 3 + 4.063 PVT*PVO*PVIB_2 4 4
+ 7.563 PVT*PVO*PVIB_2 4 5
+ 9.813 PVT*PVO*PVIB_2 4 6 + 10.81 PVT*PVO*PVIB_2 4 7
- 6.563 PVT*PVO*PVIB_2 4 8

```

* NOTE * Could not graph the specified residual type because MSE = 0 or the degrees of freedom for error = 0.

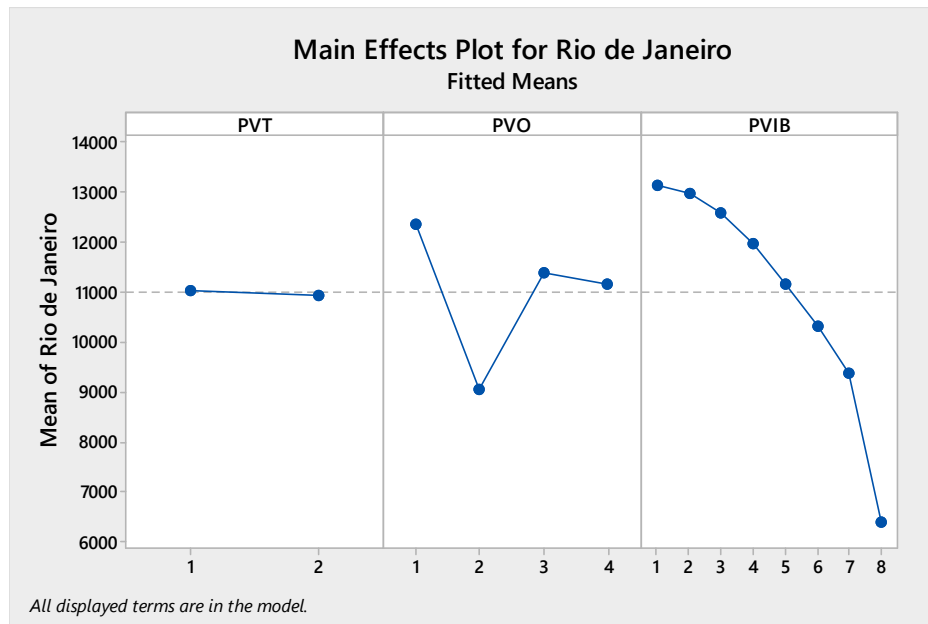


Figure S5. Main effects plot of installing PV modules on elevations for Rio de Janeiro

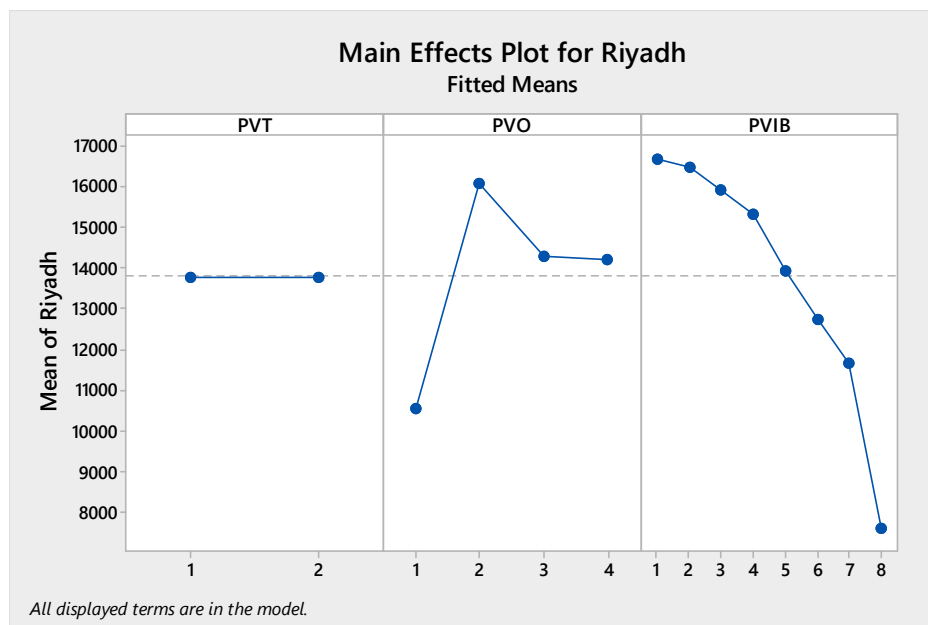


Figure S6. Main effects plot of installing PV modules on elevations for Riyadh

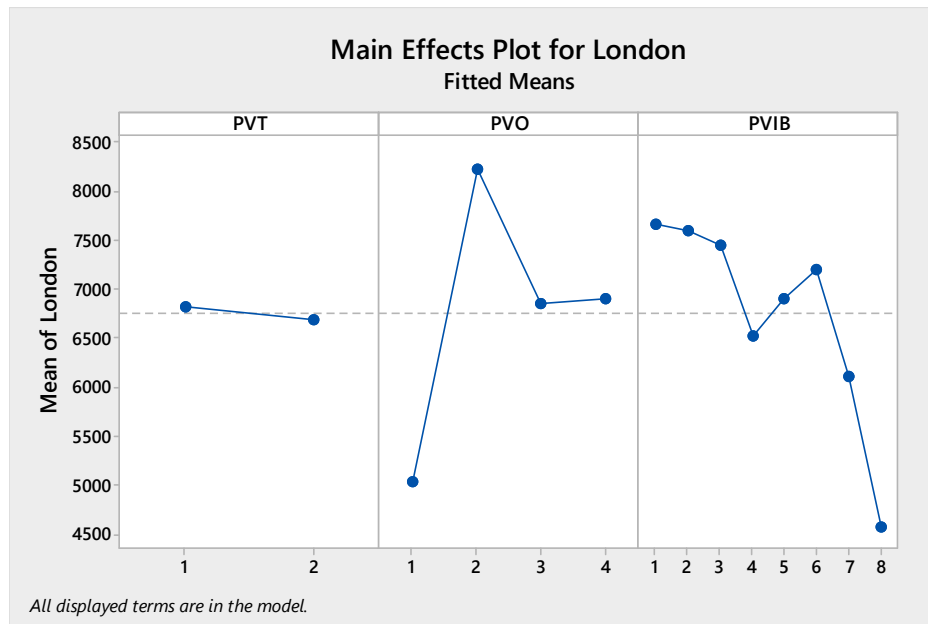


Figure S7. Main effects plot of installing PV modules on elevations for London

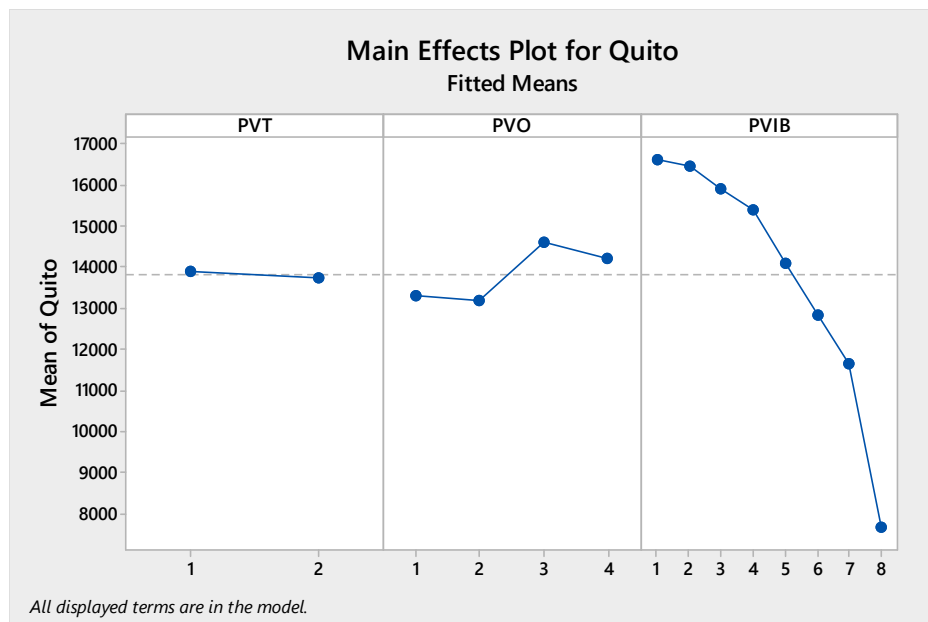


Figure S8. Main effects plot of installing PV modules on elevations for Quito